

## THE FAMILIES AND GENERA OF THE BACTERIA

### FINAL REPORT OF THE COMMITTEE OF THE SOCIETY OF AMERICAN BACTERIOLOGISTS ON CHARACTERIZATION AND CLASSIFICATION OF BACTERIAL TYPES

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#### I. INTRODUCTION

The first report of the Committee on Characterization and Classification of Bacterial Types was published in the Journal of Bacteriology for September, 1917, vol. 2, p. 505, and was discussed in some detail at the succeeding meeting of the Society.

In this preliminary report the committee reviewed briefly the historical development of systematic bacteriology from Ehrenberg to Orla-Jensen, discussed the principles of botanical nomenclature with extensive citations from the International Rules of Botanical Nomenclature, and presented a tentative system of classification of the Schizomycetes into families and genera.

The detailed classification presented was criticised in certain respects in the full discussion which followed, and in later correspondence between the committee and other members of the Society, and it was felt desirable that the scheme presented in 1917 should be revised in certain particulars and made more definite and if possible supplemented by an index of genera showing where the commoner bacterial species should be placed.

It was found impossible to complete this task and to prepare a list of approved genera for the 1918 meeting of the Society, but the task set before the committee has been at last completed and the committee is ready to make its final report at this time.

<sup>1</sup> Prof. R. S. Breed has coöperated actively in the work of the committee during the past two years, but has not felt that he could accept formal membership on the committee.

In discussions which have taken place between the members of the committee during the past two years the first question to be decided was whether the committee should simply present a list of approved genera for adoption by the Society, or should also prepare a revision of the general scheme of classification presented in 1917.

It was felt by some that the presentation by the committee of any scheme of classification would tend to give such a scheme undue authority and to impose arbitrary limits upon the development of the changing science of systematic bacteriology. It should be recognized most clearly that the limits of biological groups must always be subject to change with the growth of knowledge. The classification presented at this time seems to the committee the most reasonable outline for true biological relations among the bacteria which can be drawn up in the state of present knowledge, but this outline will necessarily be modified with the progress of investigations by individual systematists of the future. It is exceedingly improbable that any member of the committee would present the same classification in 1925 that is presented today. Indeed as to the position of certain genera the committee is itself in serious doubt at the present time.

In spite of these facts the Committee was of the opinion that it would be helpful to the members of the Society of American Bacteriologists to have the best judgment of the members of the committee as to the most natural method of classification at present available, particularly in view of the desirability of correcting certain errors in the earlier report already in type. Your committee has therefore prepared a modified arrangement of the families and genera of the Actinomycetales and Eubacterales, which is presented as section III of this report. The sequence of families and genera has no special significance, and in some cases it is doubtful in which families certain genera should be placed. The 38 genera themselves that are here presented are however believed by the committee to represent for the most part real biological groups.

The second general problem, which had to be met by the committee, concerned the method of defining bacterial genera. A

recent report of the committee on generic types of the Botanical Society of America, published in Science for April 4, 1919, has urged that the application of generic names should be determined by type species rather than by attempts at generic characterization; and with this point of view the members of the committee on characterization and classification of bacterial types are in accord. The committee was agreed that type species with proper literature references should be included in all the genera listed, but that it was also desirable to include brief characterizations of the genera themselves. The situation with which we deal in attempting to classify the bacteria is somewhat different from that which exists among the higher plants. In the latter case actual type species have been deposited in herbaria and are available for reference; while among the bacteria this is not the case except for a few type species which have recently been deposited in the collection of the American Museum of Natural History in New York. In consideration of the uncertainty which surrounds the description of many bacterial species it was felt that it would be helpful to furnish at least tentative characterizations of the genera presented, and this policy has therefore been pursued in the preparation of section III of this report.

It will perhaps be convenient to indicate briefly the general changes in classification which distinguish the present report from that of 1917. The main departures are as follows:

The group recognized in 1917 as the family Mycobacteriaceae has now been elevated to the rank of an order Actinomycetales, and divided into two families, Actinomycetaceae and Mycobacteriaceae. To the former family we have added the genera *Actinobacillus* and *Erysipelothrix*, and we have omitted *Nocardia*, which Breed (1919) has recently shown should be combined for the present with *Actinomyces*. To the second family we have added the genus *Pfeifferella*.

The Nitrobacteriaceae have been divided into two tribes, the Nitrobactereae and Azotobactereae, and the definition of the family has been modified to permit the inclusion of *Rhizobium* which recent investigations have shown to possess peritrichous flagella, but whose general characteristics ally it clearly with

*Azotobacter*. The name *Acetobacter* has been substituted for *Mycoderma* to characterize the vinegar organisms.

Among the Coccaceae a new tribe was created for the genus *Neisseria*. The genus *Albococcus* is united with *Staphylococcus* and the new genera *Diplococcus* and *Leuconostoc* are added.

The Bacteriaceae are divided into seven tribes: Chromobactereae, Erwineae, Bactereae, Lactobacilleae, Pasteurelleae, Hemophileae, and Zopfeae, and the new genera *Erythrobacillus*, *Chromobacterium*, *Zopfius*, and *Proteus* are added. The Lactobacillaceae, originally recognized as a distinct family, are thus classed as a tribe of the Bacteriaceae.

For the convenience, particularly of students, we have prepared in section IV of this report an artificial key to the families and genera of the Actinomycetales and the Eubacteriales, which we hope may be of value. It should be possible to place a key of this kind in the hands of a student and enable him at least to determine the general generic group to which any organism belongs. In the case of certain genera the specific types can be easily identified by reference to monographs such as those of Wenner and Rettger (1919) on *Proteus*, Ford (1916) on *Bacillus*, Winslow, Rothberg and Parsons (1920) on *Staphylococcus*, and Winslow, Kligler and Rothberg (1919) on *Bacterium*.

Finally in section V of this report we have presented a generic index of the commoner species of bacteria with the names ordinarily used in the texts and with the new nomenclature indicated by the proposed classification. This list has been prepared by Miss Dorothy F. Holland of the Department of Public Health of the Yale School of Medicine. It is not intended to be exhaustive or to deal in any sense with problems of *specific* identity, but merely to serve as an index of generic reference for the more familiar types.

## II. SPECIFIC RECOMMENDATIONS

The classification presented by the committee, the key and the generic index, as stated above, represent merely the consensus of opinion of the members of the committee as corresponding to the most natural system of classification indicated by present knowl-

edge. They are in no sense presented as official or binding. On the other hand in order that stability of nomenclature may be assured it is essential that certain generic names should be formally adopted by the Society, and where necessary established in the future by an International Botanical Congress, as genera conservanda. Such genera are provided for in the International Rules of Botanical Nomenclature in cases where a strict application of the rules of nomenclature, and especially the principle of priority starting from a certain date, would produce confusing and disadvantageous changes. In our own case it seems desirable to preserve in this way a number of generic names which have come into such general use that their abandonment would cause confusion, particularly in dealing with the large number of medical bacteriologists who are not familiar with the principles of botanical taxonomy. It is essential to proceed in a somewhat conservative fashion if any influence for good is to be exerted upon general practice in this field.

The following names are recommended for adoption as approved genera:

Acetobacter Fuhrmann	Leuconostoc Van Tieghem
Actinomyces Harz	Micrococcus Cohn
Bacillus Cohn	Rhizobium Frank
Bacterium Ehrenberg	Sarcina Goodsir
Chromobacterium Bergonzini	Spirillum Ehrenberg
Clostridium Prazmowski	Staphylococcus Rosenbach
Erythrobacillus Fortineau	Streptococcus Rosenbach
Leptotrichia Trevisan	Vibrio Mueller

Its work so far as possible being completed, we recommend that the Committee on Characterization and Classification of Bacterial Types be discharged and that a new Committee on Bacterial Taxonomy be appointed (1) to study and report to the Society from time to time in regard to problems of nomenclature, including such revisions of the nomenclature in the present report as may seem necessary; and (2) to take the proper steps to secure action at the next International Botanical Congress leading to the general ends contemplated in the 1916 recommendations of the Society:

- (a) That French, English or German may be substituted for Latin in the diagnosis of bacterial species.
- (b) That the date of publication of the third edition of Zopf's *Spaltpilze* (1883) be considered the beginning of bacterial nomenclature for the purpose of determining priority, with the exception of a definite list of genera conservanda.
- (c) That such of the approved generic names specified above as may be found to require such action be recognized as genera conservanda in bacterial taxonomy.<sup>2</sup>

### III. SUGGESTED OUTLINE OF BACTERIAL CLASSIFICATION

#### *THE CLASS SCHIZOMYCETES*

Minute, one-celled, chlorophyll-free, colorless, rarely violet-red or green-colored plants, which typically multiply by dividing in one, two or three directions of space. The cells thus formed are usually spherical, cylindrical, comma-shaped, spiral or filamentous and are often united into filamentous, flat, or cubical aggregates. Filamentous species often surrounded by a common sheath. The cell plasma generally homogeneous without a morphologically differentiated nucleus. Reproduction by simple fission. In many species resting bodies are produced, either endospores or gonia. Cells may be motile by means of flagella.

#### A. ORDER MYXOBACTERIALES<sup>3</sup>

Cells united during the vegetative stage into a pseudoplasmodium which passes over into a highly-developed cyst-producing resting stage.

#### B. ORDER THIOBACTERIALES<sup>3</sup>

Cells free or united in elongated filaments. Typically water forms, not cultivable on ordinary media. Life energy derived mainly from oxidative processes. Cells typically containing either granules of free sulphur or bacterio-purpurin or both, usually growing best in the presence of hydrogen sulphide.

<sup>2</sup> The Society of American Bacteriologists took favorable action on these resolutions at its meeting December 29, 1919.

<sup>3</sup> These first three orders are included briefly to give the complete setting of the fourth and fifth with which we are primarily concerned.

C. ORDER CHLAMYDOBACTERIALES<sup>3</sup>

Cells normally united in elongated filaments, often showing false but never true branching. Typically water forms. Sulphur and bacterio-purpurin are absent. Iron often present and usually a well-marked sheath.

## D. ORDER ACTINOMYCETALES Buchanan 1917a, p. 162

Cells usually elongated, frequently filamentous and with a decided tendency to the development of branches, in some genera giving rise to the formation of a definite branched mycelium. Cells frequently show swellings, clubbed or irregular shapes. No pseudo-plasmodium. No deposits of free sulphur or iron. No bacteriopurpurin. Endospores not produced, but conidia developed in some genera. Usually Gram-positive. Non-motile. Some species are parasitic in animals or plants. Not water forms. Complex proteins frequently required. As a rule strongly aerobic, (except for some species of *Actinomyces* and the genera *Fusiformis* and *Leptotrichia*) and oxidative. Growth on culture media often slow; some genera show mold-like colonies.

## FAMILY 1. ACTINOMYCETACEAE Buchanan 1918a, p. 403

Filamentous forms often branched and sometimes forming mycelia. Conidia sometimes present. Some species parasitic.

Genus 1. *Actinobacillus* Brumpt, 1900, p. 849

Filament formation, resembling streptobacilli. In lesions no mycelium formed, but at peripheries finger shaped branched cells are visible. Gram negative. Not acid fast.

Type species, *Act. Lignieresi* Brumpt.

Genus 2. *Leptotrichia* Trevisan 1879, p. 138

*Synonyms:* *Leptothrix* Robin 1847, not *Leptothrix* Keutzing 1843; not *Leptothrix* Zopf 1885; *Rasmussenia* Trevisan 1889.

Thick, long, straight or curved threads, unbranched, frequently clubbed at one end and tapering to the other. Gram positive when young. Threads fragment into short, thick rods. Anaerobic or facultative. Non-motile. Filaments sometimes granular. No aerial hyphae or conidia. Parasites or facultative parasites.

The type species is *Leptotrichia buccalis* (Robin 1847) Trevisan.

Genus 3. *Actinomyces* Harz 1877, p. 125

*Synonyms:* *Streptothrix* Cohn 1875, not *Streptothrix* Corda 1839; *Discomyces* Rivolta 1879; *Nocardia*, Trevisan 1889; *Micromyces* Gruber 1891, not *Micromyces* Dangeard 1888; *Oospora* Sauvageau and Radais 1892; not *Oospora* Wallroth 1833; *Thermoactinomyces* Tsilinsky 1899; *Cohnistreptothrix* Pinoy 1913.

Organism growing in form of a much-branched mycelium, which may break up into segments that function as conidia. Sometimes parasitic, with clubbed ends of radiating threads conspicuous in lesions in animal body. Some species are microaerophilic or anaerobic. Non-motile.

The type species is *Actinomyces bovis* Harz.

Genus 4. *Erysipelothrix* Rosenbach, 1909, p. 367

Rod-shaped organisms with a tendency to the formation of long filaments which may show branching. The filaments may also thicken and show characteristic granules. No spores. Non-motile. Gram-positive. Do not produce acid. Microaerophilic. Usually parasitic.

The type species is *Erysipelothrix rhusiopathiae* (*Bacillus rhusiopathiae suis* Kitt 1893; *Mycobacterium rhusiopathiae* Chester 1901; *Erysipelothrix porci* Rosenbach 1909), the causal organism of swine erysipelas.

FAMILY II. MYCOBACTERIACEAE Chester 1897, p. 63

Parasitic forms. Rod shaped, frequently irregular in form but rarely filamentous and with only slight and occasional branching. Often stain unevenly (showing variations in staining reaction within the cell). No conidia.

Genus 1. *Mycobacterium* Lehmann and Neumann, 1896a, p. 363

*Synonyms:* *Coccothrix* Lutz 1886; *Sclerothrix* Metschnikoff 1888, not *Sclerothrix* Kuetzing 1849; *Mycomonas* Jensen 1909.

Slender rods which are stained with difficulty, but when once stained are acid-fast. Cells sometimes show swollen, clavate or cuneate forms, and occasionally even branched cells. Non-motile, Gram-positive. No endospores. Growth on media slow. Aerobic. Several species pathogenic to animals.

The type species is *Mycobacterium tuberculosis* (Koch 1882) Lehmann and Neumann.

Genus 2. *Corynebacterium* Lehmann and Neumann 1896b, p. 350

*Synonyms:* *Corynemonas* Jensen 1909; *Corynethrix* Bongert 1901.

Slender, often slightly curved, rods with tendency to club and pointed forms, branching cells reported in old cultures. Barred uneven staining. Not acid fast. Gram-positive. Non-motile. Aerobic. No endospores. Some pathogenic species produce a powerful exotoxin. Characteristic snapping motion is exhibited when cells divide.

The type species is *Corynebacterium diphtheriae* (Loeffler 1884) Lehmann and Neumann.

Genus 3. *Fusiformis* Hoelling 1910, p. 240

*Synonym:* *Mantegazzaea* Vuillemin 1913, not *Mantegazzaea* Trevisan 1879.

Obligate parasites. Anaerobic or microaerophilic. Cells frequently elongate and fusiform, staining somewhat unevenly. Filaments sometimes formed; non-branching. Non-motile. No spores. Growth in laboratory media feeble.

The type species is *Fusiformis termitidis* Hoelling.

Non-fusiform types like *B. acne* and the anaerobic types found in Hodgkin's disease may for the present be tentatively left in this genus.

Genus 4. *Pfeifferella* Buchanan 1918b, p. 54

Non-motile rods, slender, Gram-negative, staining poorly, sometimes forming threads and showing a tendency toward branching. Gelatin may be slowly liquefied. Do not ferment carbohydrates. Growth on potato characteristically honey-like.

Type species, *Pfeifferella mallei* (Loeffler 1886) Buchanan (the glanders bacillus)

The real lines of demarcation between the genera *Actinobacillus*, *Erysipelothrix*, *Fusiformis* and *Pfeifferella* and their relations to *Actinomyces* on the one hand and to *Mycobacterium* on the other seem very obscure and the above arrangement can be considered as only tentative.

## E. ORDER EUBACTERIALES Buchanan 1917b, p. 162

The order Eubacteriales includes the forms usually termed the true bacteria, that is, those forms which are considered least differentiated and least specialized. The cell metabolism is not primarily bound up with hydrogen sulphide or other sulphur compounds, the cells in consequence containing neither sulphur granules nor bacterio-purpurin. The cells apparently do not possess a well-organized or well-differentiated nucleus. These organisms are usually minute and spherical, rod-shaped or spiral, in most genera not producing true filaments; and rarely branching. The cells may occur singly, in chains or other groupings. They may be motile by means of flagella, or non-motile; but are never notably flexuous. Cell multiplication occurs always by transverse, never by longitudinal fission. Some genera produce endospores, particularly the rod-shaped types. Conidia not observed. Chlorophyll is absent, though the cells may be pigmented. The cells may be united into gelatinous masses, but never form motile pseudo-plasmodia nor develop a highly specialized cyst-producing fruiting stage, such as is characteristic of the *Myxobacterales*.

## Family I. NITROBACTERIACEAE Buchanan, 1917c, p. 349

Organisms usually rod-shaped (sometimes nearly spherical in *Nitrosomonas* and possibly in *Azotobacter*.) Cells motile or non-motile. Branched involution forms in *Rhizobium* and *Aceto-*

bacter. Endospores never formed. Obligate aerobes, capable of securing growth energy by the direct oxidation of carbon, hydrogen or nitrogen or of simple compounds of these. Non-parasitic (except in genus *Rhizobium*)—usually water or earth forms.

#### Tribe I. NITROBACTEREAE

Organisms deriving their life energy from oxidation of simple compounds of carbon and nitrogen (or of alcohol).

##### Genus 1. *Hydrogenomonas* Orla-Jensen 1909, p. 311

Monotrichic short rods capable of growing in the absence of organic matter, and securing growth energy by the oxidation of hydrogen (forming water). Kaserer (1905) who first described the organism states that his species will also grow well on a variety of organic substances.

The type species is *Hydrogenomonas pantotropha* (Kaserer 1906) Orla-Jensen. Nikleuski (1910) described two additional species, *H. vitrea* and *H. flava*.

##### Genus 2. *Methanomonas* Orla-Jensen 1909, p. 311

Monotrichic short rods capable of growing in the absence of organic matter and securing growth energy by the oxidation of methane (forming carbon dioxide and water). The type species is *Methanomonas methanica* (Söhngen 1906) Orla-Jensen.

##### Genus 3. *Carboxydomonas* Orla-Jensen 1909, p. 311

Autotrophic rod-shaped cells capable of securing growth energy by the oxidation of carbon monoxide (forming carbon dioxide). The type species, *Carboxydomonas oligocarbophila* (Beijerinck and van Delden 1903) Orla-Jensen, is described as non-motile.

##### Genus 4. *Acetobacter* Fuhrmann 1905, p. 8

*Synonyms:* *Mycoderma* Persoon 1822; *Ulvina* Kuetzing 1837; *Umbina* Naegeli 1849; *Bacteriopsis*? Trevisan 1885; *Gliacoccus* Maggi 1886; *Acetimonas* Jensen 1909.

Cells rod-shaped, frequently in chains, non-motile. Cells grow usually on the surface of alcoholic solutions as obligate aerobes, securing growth energy by the oxidation of alcohol to acetic acid. Also capable of utilizing certain other carbonaceous compounds, as sugar and acetic acid. Elongated, filamentous, club-shaped, swollen and even branched cells may occur as involution forms.

The type species is *Acetobacter aceti* (Thomson 1852), Committee.

Genus 5. *Nitrosomonas* Winogradsky 1892a, p. 127

Includes *Nitrosococcus* Winogradsky 1892

Cells rod-shaped or spherical, motile or non-motile, if motile with polar flagella. Capable of securing growth energy by the oxidation of ammonia to nitrites. Growth on media containing organic substances scanty or absent.

The type species is *Nitrosomonas europaea* Winogradsky.

Genus 6. *Nitrobacter* Winogradsky 1892b, p. 87

Synonym: *Nitrosobacterium?* Rullmann 1897.

Cells rod-shaped, non-motile, not growing readily on organic media or in the presence of ammonia. Cells capable of securing growth energy by the oxidation of nitrites to nitrates.

The type species is *Nitrobacter Winogradskyi*, Committee 1917a, p. 552.

Tribe 2. AZOTOBACTEREAE

Nitrogen-fixing organisms

Genus 7. *Azotobacter* Beijerinck 1901a, p. 561

Synonyms: *Parachromatium* Beijerinck 1903; *Azotomonas* Jensen 1909.

Relatively large rods, or even cocci, sometimes almost yeast-like in appearance, dependent primarily for growth energy upon the oxidation of carbohydrates. Motile or non-motile; when

motile, with tuft of polar flagella. Obligate aerobes usually growing in a film upon the surface of the culture medium. Capable of fixing atmospheric nitrogen when grown in solutions containing carbohydrates and deficient in combined nitrogen.

The type species is *Azotobacter chroococcum* Beijerinck.

Genus 8. *Rhizobium* Frank, 1889, p. 338.

*Synonyms:* *Phytomyxa* Schroeter 1886; *Cladochytrium* Vuillemin 1888; *Rhizobacterium* Kirchner 1895; *Pseudorhizobium* Hartleb 1900; *Rhizomonas* Jensen 1909.

Comment. *Phytomyxa* Schroeter has priority over *Rhizobium*, but because of the confusion which would arise from the substitution of the older correct name for the better known term *Rhizobium*, the committee recommends the adoption of the latter.

Minute rods, motile when young. Involution forms abundant and characteristic when grown under suitable conditions. Obligate aerobes, capable of fixing atmospheric nitrogen when grown in the presence of carbohydrates in the absence of compounds of nitrogen. Produce nodules upon the roots of leguminous plants.

The type species is *Rhizobium leguminosarum* Frank.

## FAMILY II. PSEUDOMONADACEAE, Committee 1917b, p. 555

Rod-shaped, short, usually motile by means of polar flagella or rarely non-motile. Aerobic and facultative. Frequently gelatin liquefiers and active ammonifiers. No endospores. Gram stain variable, though usually negative. Fermentation of carbohydrates as a rule not active. Frequently produce a water-soluble pigment which diffuses through the medium as green, blue, purple, brown, etc. In some cases a non-diffusible yellow pigment is formed. Many yellow species are plant parasites.

Genus 1. *Pseudomonas* Migula 1894, p. 237, emended

*Synonyms:* *Bacterium* Ehrenberg emended Cohn 1872; *Bactrillum* Fischer 1895; *Arthrobacterinium* Fischer 1895; *Arthrobactrillum* Fischer 1895; *Eupseudomonas* Migula 1895; *Bactrinius* Kendall 1902; *Bactril-*

*lius* Kendall 1902; *Bacterium* Ehrenberg emended E. F. Smith 1905; *Denitromonas* Jensen 1909; *Liquidomonas* Jensen 1909.

Characters, those of family.

Type species, *Ps. aeruginosa* (Schroeter) Frost?

FAMILY III. SPIRILLACEAE. Migula 1894, p. 237

Cells elongate, more or less spirally curved. Cell division always transverse, never longitudinal. Cells non-flexuous. Usually without endospores. As a rule motile by means of polar flagella, sometimes non-motile. Typically water forms, though some species are intestinal parasites.

Genus 1. *Vibrio* Mueller 1786, p. 39, emended E. F. Smith 1905

Synonyms: *Pacinia* Trevisan 1885; *Microspira* Schroeter 1886; *Pseudospira* De Toni and Trevisan 1889; *Liquidovibrio* Jensen 1909; *Solidovibrio* Jensen 1909; *Photobacterium?* Beijerinck 1889.

Cells short bent rods, rigid, single or united into spirals. Motile by means of a single (rarely two or three) polar flagellum, which is usually relatively short. Many species liquefy gelatin and are active ammonifiers. Aerobic and anaerobic. No endospores. Usually Gram-negative. Water forms, a few parasites.

The type species is *Vibrio comma* (Koch 1884) Schroeter 1886.

Genus 2. *Spirillum* Ehrenberg 1830, p. 38 emended Migula 1894, p. 237

Synonyms: *Spirobacillus?* Metschnikoff 1889; *Spirosoma* Migula 1894; *Sporospirillum?* Jensen 1909.

Cells, rigid rods of various thicknesses, length, and pitch of the spiral, forming either long screws or portions of a turn. Usually motile by means of a tuft of polar flagella (5 to 20) which are mostly half circular, rarely wavy-bent. These flagella occur on one or both poles; their number varies greatly and is difficult to determine; since in stained preparations several are often united into a common strand. Endospore formation has been reported in some species. Habitat: water or putrid infusions.

Type species *Spirillum undula* (Mueller 1786) Ehrenberg.

## FAMILY IV. COCCACEAE Zopf 1884, p. 45, emended Migula 1894

*Synonyms:* *Sphaerobacteria* Cohn 1872; *Coccaceen* Zopf 1884; *Coccogenae* Trevisan 1885; *Coccacei* Schroeter 1886; *Coccobacteria* Schroeter 1886; *Sphaerobacteries* Maggi 1886; *Kokkaceen* Hueppe 1886; *Coccacees* Mace 1897.

Cells in their free conditions, spherical; during division somewhat elliptical. Division in one, two or three planes. If the cells remain in contact after division they are frequently flattened in the plane of division, and form chains, packets or irregular masses. Motility rare. Endospores absent. Metabolism complex, usually involving the utilization of amino-acids or carbohydrates. Pigment often produced.

## Tribe A. NEISSERAE, Nov. Trib.

Strict parasites, failing to grow or growing very poorly on artificial media. Cells normally in pairs. Gram-negative. Growth fairly abundant on serum media.

Genus 1. *Neisseria* Trevisan 1885, p. 105

*Synonyms:* *Diplococcus* Weichselbaum 1886 in part; *Gonococcus?* Neisser? 1879; *Merismopedia* Zopf 1885; not *Merismopedia* Meyen 1839.

Characters, those of tribe.

Type species, *N. gonorrhoeae* Trevisan.

## Tribe B. STREPTOCOCCEAE Trevisan, 1889a, p. 1051 emended

Parasites (thriving only or best on or in the animal body) except genus *Leuconostoc*. Grow well under anaerobic conditions. Many forms grow with difficulty on serum-free media, none very abundantly. Planes of fission usually parallel, producing pairs or short or long chains, never packets. Generally stain by Gram. Produce acid but no gas in glucose and generally in lactose broth. Pigment, if any, white or orange.

Genus 2. *Diplococcus* Weichselbaum 1886, p. 506 emended

*Synonyms:* *Klebsiella* Trevisan 1885, in part; *Hyalococcus* Schroeter 1886; *Pseudodiplococcus* Bonome, 1888; *Pneumococcus?* Schmidlechner 1905.

Parasites, growing poorly, or not at all, on artificial media. Cells usually in pairs of somewhat elongated cells, often capsulated, sometimes in chains. Gram positive. Fermentative powers high, most strains forming acid in glucose, lactose, sucrose and inulin.

Type species, *D. pneumoniae* Weichselbaum.

Genus 3. *Leuconostoc* Van Tieghem 1878, p. 198, emended

*Synonyms:* *Ascococcus* Cienkowski 1878; not *Ascococcus* Cohn 1875; *Leucocystis?* Schroeter 1886.

Saprophytes, usually growing in cane sugar solutions. Cells in chains or pairs, united in large zoogloal masses. Some types at least Gram negative.

Type species, *L. mesenteroides* (Cienkowski) Van Tieghem.

Genus 4. *Streptococcus* Rosenbach 1884a, p. 22, emended  
Winslow and Rogers 1905, p. 669

*Synonyms:* *Sphaerococcus* Marpmann 1885, not *Sphaerococcus* Agardh 1821; *Arthrostreptokokkus* Hueppe 1886; *Perroncitoa* Trevisan 1889; *Babesia?* Trevisan 1889; *Schuetzia* Trevisan 1889; *Lactococcus* Beijerinck 1901; *Hypnocoluss* Bettencourt et al. 1904; *Myxokokkus* Gonnermann 1907, not *Myxococcus* Thaxter 1892; *Melococcus?* Amiradzibi 1907; *Diplostreptococcus* Lingelsheim 1912

Chiefly parasites. Cells normally in short or long chains (under unfavorable conditions, sometimes in pairs and small groups, never in large packets). Generally stain by Gram. Capsules rarely present, no zoogloal masses. On agar streak, effused translucent growth, often with isolated colonies. In stab culture, little surface growth. Many sugars fermented with formation of large amount of acid, but inulin is rarely attacked. Generally fail to liquefy gelatin or reduce nitrates.

Type species is *Streptococcus pyogenes* Rosenbach.

Genus 5. *Staphylococcus* Rosenbach 1884b, p. 19

*Synonyms:* *Micrococcus* Cohn 1872 em. Migula 1894; *Botryomyces* Bollinger 1888; *Botryococcus* Kitt 1888, not *Botryococcus* Kuetzing 1849; *Galactococcus* Guillebeau; *Bollingera* Trevisan 1889; *Gaffkya* Trevisan 1885; *Pyococcus* Ludwig 1892; *Carphococcus* Hohl 1902; *Albococcus* Winslow and Rogers 1906; *Aurococcus* Winslow and Rogers 1906; *Indolococcus* Jensen 1909; *Liquidococcus* Jensen 1909; *Peptonococcus* Jensen 1909; *Enterococcus?* (Thiercelin) Rougentzoff 1914.

Parasites. Cells in groups and short chains, very rarely in packets. Generally stain by Gram. On agar streak good growth, of white or orange color. Glucose, maltose, sucrose and often lactose, fermented with formation of moderate amount of acid. Gelatin often liquefied very actively.

Type species is *Staphylococcus aureus* Rosenbach.

Tribe C. **MICROCOCCEAE** Trevisan, 1889b, p. 1067, emended  
(as **METACOCCACEAE**) Winslow and Rogers 1905, p. 669

Facultative parasites or saprophytes. Thrive best under aerobic conditions. Grow well on artificial media, producing abundant surface growths. Planes of fission often at right angles; cell aggregates in groups, packets or zoogloal masses. Generally decolorize by Gram. Pigment yellow or red.

Genus 6. *Micrococcus* Cohn 1872 a, p. 153, emended Winslow  
and Rogers, 1905, p. 669

*Synonyms:* *Microsphaera* Cohn 1872, not *Microsphaera* Leveille 1851; *Ascococcus* Cohn, 1875; *Pediococcus* Balcke 1884; *Merista* Van Tieghem 1884, not *Merista* (Banks and Soland) Cunningham 1839; *Planococcus* Migula 1894; *Urococcus* Miquel 1879; not *Urococcus* Kuetzing 1849; *Carphococcus* Hohl 1902; *Pedioplana* Wolff 1907; *Tetradiplococcus?* Bartoszewicz and Schwarzwasser 1906; *Solidococcus* Jensen 1909; *Plano-merista* Vuillemin 1913.

Facultative parasites or saprophytes. Cells in plates or irregular masses (never in long chains or packets). Generally decolorize by Gram. Growth on agar abundant, with formation

of yellow pigment. Glucose broth slightly acid, lactose broth generally neutral. Gelatin frequently liquefied, but not rapidly.

The type species is *Micrococcus luteus* (Schroeter) 1872b, Cohn.

Genus 7. *Sarcina* Goodsir 1842, p. 432, emended Winslow and Rogers 1905, p. 359

*Synonyms:* *Urosarcina* Miquel 1879; *Planosarcina* Migula 1894; *Pseudosarcina?* Maze 1903; *Tetradiplococcus?* Bartoszewicz and Schwarzwasser 1908; *Lactosarcina* Beijerinck 1908; *Sporosarcina?* Jensen 1909.

*Sarcina* differs from *Micrococcus* solely in the fact that cell division occurs under favorable conditions in three planes, forming regular packets.

The type species is *Sarcina ventriculi* Goodsir.

Genus 8. *Rhodococcus* Zopf 1891, p. 28, emended Winslow and Rogers 1906, p. 546

*Synonyms:* Not *Rhodococcus* Molisch 1907.

Saprophytes. Cells in groups or regular packets. Generally decolorize by Gram. Growth on agar abundant with formation of red pigment. Glucose broth slightly acid, lactose broth neutral. Gelatin rarely liquefied. Nitrates generally reduced.

Type species, *Rhodococcus rhodochrous* Zopf.

FAMILY V. BACTERIACEAE Cohn 1872b, p. 231  
Emended Committee 1917c, p. 560

Rod-shaped cells without endospores. Usually Gram-negative. Flagella when present peritrichic. Metabolism complex, amino-acids being utilized, and generally carbohydrates.

Tribe 1. *Chromobactereae*, Nov. Trib.

Water bacteria producing a red or violet pigment.

Genus 1. *Erythrobacillus*, Fortineau 1905, p. 104

*Synonyms:* *Zaogalactina* Sette 1824; *Serratia* Bizio, 1825; *Bacillus*, in part, of many authors.

Small aerobic bacteria, producing a red or pink pigment, usually a lipochrome. Gram stain variable. It is possible that related yellow and orange chromogens should be included here as well.

Type species, *Erythrobacillus prodigiosus* (Ehrenberg) Committee.

Genus 2. *Chromobacterium* Bergonzini 1881, p. 153

*Synonyms:* The name was spelled *Cromobacterium* by Bergonzini and corrected by Zimmerman 1881.

Aerobic bacteria, producing a violet chromoparous pigment, soluble in alcohol but not in chloroform. Motility and Gram reaction variable.

Type species, *Chr. violaceum* Bergonzini.

## Tribe 2. ERWINEAE, Nov. Trib.

Plant pathogens. Growth usually whitish, often slimy. Indol generally not produced. Acid usually formed in certain carbohydrate media, but as a rule no gas.

Genus 3. *Erwinia* Committee 1917d, p. 560.

Characters those of the tribe.

Type species, *E. amylovora* (Burrill 1883, p. 319; Trevisan 1889, p. 19) Committee 1917.

## Tribe 3. ZOPFEAE, Nov. Trib.

Gram positive rods, growing freely on artificial media. Not attacking carbohydrates.

Genus 4. *Zopfius*, Wenner and Rettger, 1919, p. 334

*Synonyms:* *Bacterium* Ehrenberg 1828 in part; *Bacillus* Cohn, 1872 in part; *Proteus* Hauser 1885, in part.

Long rods occurring in evenly curved chains. Gram positive. Motile. Proteus-like growth on media. Facultative anaerobes. Carbohydrates and gelatin not attacked, hydrogen sulphide not formed.

Type species, *Z. zoppii* (Kurth) Wenner and Rettger.

Tribe 4. BACTEREAE, Nov. Trib.

Gram negative rods growing freely on artificial media. Generally forming acid from carbohydrates and often gas composed of CO<sub>2</sub> and H<sub>2</sub>.

Genus 5. *Proteus* Hauser 1885, p. 1

*Synonyms:* *Spirulina* Hueppe 1886; not *Spirulina* Turpin 1827; *Liquidobacterium* Jensen 1909.

Highly pleomorphic rods, filaments and curved cells being common as involution forms. Gram negative. Actively motile. Characteristic amoeboid colonies on moist media. Liquefy gelatin rapidly and produce vigorous decomposition of proteins. Ferment glucose and sucrose (but usually not lactose), with formation of acid and gas (the latter being CO<sub>2</sub> only).

Type species, *P. vulgaris* Hauser.

Genus 6. *Bacterium* Ehrenberg 1828, emended Orla-Jensen 1909, p. 315

*Synonyms:* *Tyrothrix* Duclaux 1879; *Actinobacter* Duclaux 1882 in part; *Klebsiella* Trevisan 1885 in part; *Kurthia?* Trevisan 1885; *Glycrobacterium* Malerba and Sanna Salaris 1888; *Pneumobacillus?* Arloing 1889; *Aerobacter* Beijerinck 1900; *Salmonella* Lignieres 1900; *Pyobacillus* Koppányi 1907.

Gram negative, evenly staining rods. Often motile, with peritrichic flagella. Easily cultivable, forming grape-vine leaf or convex whitish surface colonies. Liquefy gelatin rarely. All forms except *B. alcaligenes* and the *B. abortus* group attack the hexoses and most species ferment a large series of carbohydrates. Acid formed by all, gas (CO<sub>2</sub> and H<sub>2</sub>) only by one series. Typi-

cally intestinal parasites of man and the higher animals although several species may occur on plants and one (*B. aerogenes*) is widely distributed in nature. Many species pathogenic.

Type species, *B. coli* Escherich 1885, p. 518.

#### Tribe 5. LACTOBACILLEAE, Nov. Trib.

Rods, often long and slender, Gram-positive, non-motile, without endospores. Usually produce acid from carbohydrates, as a rule lactic. When gas is formed, it is CO<sub>2</sub> without H<sub>2</sub>. The organisms are usually somewhat thermophilic. As a rule micro-aerophilic; surface growth on media poor.

Genus 7. *Lactobacillus* Beijerinck 1901b, p. 214

*Synonyms:* *Dispora?* Kern 1882; *Tyrothrix?* Duclaux 1882 in part; *Saccharobacillus?* van Laer 1889; *Lactobacter* Beijerinck 1901; *Streptobacillus* Rest and Khouri 1902; *Brachybacterium* Troili-Petersson 1903; *Caseobacterium* Jensen 1909.

Generic characters those of the tribe.

The type species is *Lactobacillus caucasicus* (Kern?) Beijerinck.

#### Tribe 6. Pasteurelleae, Nov. Trib.

Gram negative rods, showing bipolar staining. Parasitic forms of slight fermentative power.

Genus 8. *Pasteurella* Trevisan 1888, p. 7.

*Synonyms:* *Octopsis?* Trevisan 1885; *Coccobacillus* Gamaleia 1888, not *Coccobacillus* Leube 1885; *Dicoccia?* Trevisan 1889; *Diplobacillus?* Wechselbaum 1887.

Aerobic and facultative. Powers of carbohydrate fermentation slight; no gas produced. Gelatin not liquefied. Parasitic, frequently pathogenic, producing plague in man and hemorrhagic septicemia in the lower animals.

The type species is *Pasteurella cholerae-gallinarum* (Flügge 1886) Trevisan.

## Tribe 7. HEMOPHILAEAE, Nov. Trib.

Minute parasitic forms growing only in presence of hemoglobin, ascitic fluid or other body fluids.

Genus 9. *Hemophilus* Committee 1917c, p. 561

*Synonyms:* *Pyobacillus?* Koppanyi 1907; *Diplobacillus* Morex 1896, not *Diplobacillus* Wechselbaum 1887.

Minute rod-shaped cells, sometimes thread forming and pleomorphic, nonmotile, without spores, strict parasites, growing best (or only) in the presence of hemoglobin, and in general requiring blood serum or ascitic fluid. Gram negative.

The type species is *Hemophilus influenzae* (Pfeiffer 1893, p. 357) Committee 1917.

## FAMILY VII. BACILLACEAE Fischer 1895, p. 139

Rods producing endospores, usually Gram-positive. Flagella when present peritrichic. Often decompose protein media actively through the agency of enzymes.

Genus 1. *Bacillus* Cohn, 1872c, p. 174

*Synonyms:* *Bactrella?* Morren 1830; *Metallacter?* Perty 1852; *Bactridium* Davaine 1868 in part; *Urobacillus* Miquel 1879; *Pollendera* Trevisan 1884; *Zopfiella* Trevisan 1885; *Streptobacter* Schroeter 1886; *Cornilia* Trevisan 1889 in part; *Bacterium* Ehrenberg, emended Migula 1894 in part; *Bactridium* Fischer 1895, not *Bactridium* Wallroth 1832; *Bactrinium* Fischer 1895; *Bactrillum* Fischer 1895; *Endobacterium* Lehmann and Neumann 1896; *Astasia* Meyer 1898; *Fenobacter* Beijerinck 1900; *Bacterius* Kendall 1902 in part; *Aplanobacter* E. F. Smith 1905 in part; *Semiclostridium* Maassen 1905; *Plennbakertum* Gonnermann 1907; *Myxobacillus* Gonnermann 1907; *Thermobacillus* Jensen 1909; *Serratia* Vuillemin 1913 in part, not *Serratia* Bizio 1823.

Aerobic forms. Mostly saprophytes. Liquefy gelatin. Often occur in long threads and form rhizoid colonies. Form of rod usually not greatly changed at sporulation.

The type species is *Bacillus subtilis* Cohn.

Genus 2. *Clostridium* Prazmowski 1880, p. 23

*Synonyms:* *Amylobacter* Trecul 1865; *Cornilia* Trevisan 1889 in part; *Granulobacter* Beijerinck 1893; *Clostrillum* Fischer 1895; *Clostrinum* Fischer 1895; *Paracloster* Fischer 1895; *Semiclostridium* Maassen 1905; *Botulobacillus* Jensen 1909; *Butyribacillus* Jensen 1909; *Cellulobacillus* Jensen 1909; *Putribacillus* Jensen 1909.

Anaerobes or micro-aerophiles. Often parasitic. Rods frequently enlarged at sporulation, producing clostridium or plectridium forms.

The type species is *Clostridium butyricum* Prazmowski.

#### IV. ARTIFICIAL KEY TO THE FAMILIES AND GENERA OF THE ACTINOMYCETALES AND EUBACTERIALES

- A. Typically filamentous forms. *Actinomycetaceae*
  - B. Mycelium and conidia formed.....*Actinomyces*
  - BB. No true mycelium
    - C. Cells show branching
      - D. Gram negative.....*Actinobacillus*
      - DD. Gram positive.....*Erysipelothrrix*
    - CC. Cells never branch. Gram positive threads later fragmenting into rods.....*Leptotrichia*
  - AA. Typically unicellular forms (although chains of cells may occur)
    - B. Spherical cells. *Coccaceae*
      - C. Parasitic forms. Cells in pairs, chains or irregular groups, never in packets. Generally active fermenters
      - D. Cells in flattened coffee-bean-like pairs
        - Gram negative.....*Neisseria*.
      - DD. Cells not as above. Gram positive
        - E. Cells in lanceolate pairs or chains
          - Growth on media not abundant
            - F. Cells in lanceolate pairs. Inulin generally fermented..*Diplococcus*
            - FF. Cells in chains. Inulin generally not fermented....*Streptococcus*
          - EE. Cells in irregular groups. Growth on media fairly vigorous. White or orange pigment.....*Staphylococcus*
      - CC. Saprophytic forms. Chains occurring in zoogelous masses in sugar solutions.....*Leuconostoc*
      - CCC. Saprophytic forms. Cells in irregular groups or packets, not in chains. Fermentative powers low
        - D. Packets formed.....*Sarcina*
        - DD. No packets
          - E. Yellow pigment.....*Micrococcus*
          - EE. Red pigment.....*Rhodococcus*

## BB. Rods

- C. Curved rods. *Spirillaceae*
  - D. Short comma-like rods. One-three short flagella..... *Vibrio*
  - DD. Long spirals, five-twenty flagella..... *Spirillum*
- CC. Straight rods
  - D. No endospores
    - E. Rods of irregular shape or showing branched or filamentous involution forms.
    - F. Animal parasites. Cells of irregular shape. Staining unevenly.
    - G. Acid fast..... *Mycobacterium*
    - GG. Not acid fast
      - H. Cells elongate, fusiform..... *Fusiformis*
      - HH. Cells not fusiform, sometimes branching
        - I. Gram positive. Slender, sometimes clubbed rods..... *Corynebacterium*
        - II. Gram negative. Rods sometimes form threads. Characteristic honey-like growth on potato.. *Pfeifferella*
    - FF. Not animal parasites. Cells staining unevenly and with branched or filamentous forms at certain stages. Never acid fast.
    - G. Metabolism simple, growth processes involving oxidation of alcohol or fixation of atmospheric nitrogen (later in symbiosis with green plants)
      - H. Cells minute, symbiotes in roots of leguminous plants..... *Rhizobium*
      - HH. Oxidizing alcohol, branching forms common.... *Acetobacter*
    - GG. Not as above. Proteus-like colonies.
      - H. Not attacking carbohydrates. Gram +..... *Zopfius*
      - HH. Fermenting glucose and sucrose. Gram - ..... *Proteus*
  - EE. Regularly formed rods
    - F. Metabolism simple, growth processes involving oxidation of carbon, hydrogen or their simple compounds or the fixation of atmospheric nitrogen. *Nitrobacteriaceae*
      - G. Fixing nitrogen or oxidizing its compounds
        - H. Fixing nitrogen
          - Cells large; in soil..... *Azotobacter*
          - HH. Oxidizing nitrogen compounds
            - I. Oxidizing ammonia..... *Nitrosomonas*
            - II. Oxidizing nitrites..... *Nitrobacter*
        - GG. Not as above
          - H. Oxidizing hydrogen..... *Hydrogenomonas*
          - HH. Not as above, using simpler carbon compounds
            - I. Oxidizing CO..... *Carboxydomonas*
            - II. Oxidizing CH<sub>4</sub>..... *Methanomonas*
      - FF. Not as above
        - G. Flagella usually present, polar.
          - Pseudomonadaceae*..... *Pseudomonas*
        - GG. Flagella when present peritrichic.
          - Bacteriaceae*

- H. Parasitic forms showing bipolar staining ..... *Pasteurella*
- HH. Not as above
- I. Strict parasites growing only in presence of hemoglobin or ascitic fluid ..... *Hemophilus*
- II. Not as above
- J. Water forms producing red or violet pigment
  - K. Pigment red ..... *Erythrobacillus*
  - KK. Pigment violet ..... *Chromobacterium*
- JJ. Not as above
  - K. Plant pathogens ..... *Erwinia*
  - KK. Not as above
    - L. Gram positive, forming large amount of acid from carbohydrates and sometimes CO<sub>2</sub> but no H<sub>2</sub> ..... *Lactobacillus*
    - LL. Gram negative, forming H<sub>2</sub> as well as CO<sub>2</sub>, if gas is produced ..... *Bacterium*
- DD. Endospores present, *Bacillaceae*.
- E. Aerobes ..... *Bacillus*
- EE. Anaerobes ..... *Clostridium*

## V. GENERIC INDEX OF THE COMMONER FORMS OF BACTERIA

PREPARED FOR THE COMMITTEE BY DOROTHY F. HOLLAND,  
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The following index is not intended to be exhaustive or to deal in any sense with problems of *specific* identity. The literature has not been comprehensively studied and no attempt has been made to arrive at conclusions in regard to the priority of specific names. The list is simply an index of reference to show how the *names of species* commonly found in the literature should be changed to correspond with the generic classification suggested by the committee. Many of the specific names quoted are known to be synonyms, and the list is therefore in no sense a check list of valid bacterial species. Our hope is that those who wish to use the committee classification can by reference to this list easily replace the older form of any specific name by the newer one which it should bear in accord with the generic arrangement presented above; and in particular that it will facilitate the breaking up of the absurdly incongruous aggregates massed together under the older names *Bacillus* and *Bacterium*.

<i>Acetobacter aceti</i> (Thomson)	<i>Actinomyces—Continued.</i>
<i>xylinum</i> (Brown)	<i>melanocyclus</i> Krainsky
<i>Actinobacillus Lignieresi</i> Brumpt	<i>melanosporous</i> Krainsky
<i>Actinomyces</i>	<i>necrophorus</i> Loeffler
<i>albido-flavus</i> Rossi-Doria	<i>pheochromogenus</i> Conn
<i>alboflavus</i> Waksman & Curtis	<i>pleuricolor</i>
<i>albosporous</i> (Krainsky?) Waksman & Curtis	<i>Poolensis</i> Taubenhaus
<i>albus</i> (Krainsky?) Waksman & Cur- tis	<i>pulmonalis</i>
<i>asteroides</i> (Eppinger) Gasperini	<i>Rosenbachii</i> Kruse
<i>aurantiacus</i> (Rossi-Doria) Gasperini	<i>roseus</i> (Krainsky?) Waksman & Cur- tis
<i>aureus</i> Waksman & Curtis	<i>rubidaureus</i> (Thiry) Lachner
<i>bobili</i> Waksman & Curtis	<i>rubrus</i> Kruse
<i>bovis</i> Harz	<i>Rutgersensis</i> Waksman & Curtis
<i>Californicus</i> Waksman & Curtis	<i>scabies</i> (Thaxter) Güssow
<i>carneus</i> (Rossi-Doria) Gasperini	<i>thermophilus</i> Gilbert
<i>chromogenus</i> Gasperini	<i>verne</i> Waksman & Curtis
<i>citreus</i> (Krainsky?) Waksman & Cur- tis	<i>violaceus</i> (Rossi-Doria) Gasperini
<i>diastaticus</i> (Krainsky?) Waksman & Curtis	<i>violaceus-ruber</i> Waksman & Curtis
<i>exfoliatius</i> Waksman & Curtis	<i>violaceus-acesari</i> Waksman & Curtis
<i>farcinicus</i> (Trev. and de Toni) Gas- perini	
<i>flavus</i> Sanfelice	
<i>Foersteri</i> (Cohn) Gasperini	<b>Azotobacter</b>
<i>fradii</i> Waksman & Curtis	<i>agile</i> Beijerinck
<i>griseus</i> (Krainsky?) Waksman & Curtis	<i>Beijerinckii</i> Lipman
<i>Halstedii</i> Waksman & Curtis	<i>chroococcum</i> Beijerinck
<i>Hofmanni</i> (Gruber) Gasperini	<i>Vinelandii</i> Lipman
<i>Isreali</i> Kruse	<i>Woodstowii</i> Lipman
<i>invulnerabilis</i> (Acosta-Grande-Ros- si) Kruse	
<i>Krausei</i>	<b>Bacillus</b>
<i>lavendulae</i> Waksman & Curtis	<i>abortivius</i> ( <i>see</i> <i>Bact. abortivium</i> )
<i>Lipmanii</i> Waksman	<i>abortus</i> Bang <sup>4</sup> ( <i>see</i> <i>Bact. abortum</i> )
<i>madurae</i> (Vincent) Leh. and Neu.	<i>abortus-equii</i> ( <i>see</i> <i>Bact. abortum-         equi</i> )
	<i>acidi-lactici</i> Grotenfelt ( <i>see</i> <i>Bact.         acidi-lactici</i> )
	<i>acidificans-longissimus</i> ( <i>see</i> <i>Lacto-         bacillus acidificans-longissimus</i> )
	<i>acidophil-aerogenes</i> Torrey-Rahe ( <i>see</i> <i>Lactobacillus acidophil-aero-         genes</i> )

<sup>4</sup> *B. bronchisepticus*, *B. abortus*, *B. melitensis* according to Evans (Further Studies on *Bact. abortus* and Related Bacteria) J. Infect. Dis., Vol. 22, No. 6, p. 580) are related morphologically, culturally, biochemically, and serologically. They are Gram negative, do not form spores, "do not attack the sugars nor the other commonly used fermentable test substances." These organisms should probably constitute a distinct new genus, but we have hesitated to add new generic names at this time without further study of our own.

## Bacillus—Continued.

*acidophilus* Moro (*see Lactobacillus acidophilus*)  
*acnes* (*see Fusiformis acnes*)  
*adhaerens* Ford  
*aerogenes* Escherich (*see Bact. aerogenes*)  
*aerogenes-capsulatus* Welch & Nuttall (*see Clostridium aerogenes-capsulatum*)  
*aeruginosus* Schröter (*see Pseudomonas aeruginosa*)  
*agri* Ford  
*albolactus* Migula  
*alcaligenes* Petruschky (*see Bact. alcaligenes*)  
*amethystinus* Eisenberg (*see Chromobacterium amethystinum*)  
*amylobacter* van Tieghem (*see Clostridium amylobacter*)  
*amyloruber* Hefferan (*see Erythrobacillus amyloruber*)  
*amylovorus* (Burrill-Trev.) *see Erwinia amylovora*  
*anaerogenes* Lembke (*see Bact. anaerogenes*)  
*anthracis* Koch-Cohn  
*anthracis-symptomatici* Kruse (*see Clostridium anthracis-symptomatici*)  
*anthracoides* Hueppe-Wood  
*aquatilis* Tataroff (*see Pseudomonas aquatilis*)  
*arborescens* Frankland (*see Erythrobacillus arborescens*)  
*astheniae* Dawson (*see Bact. astheniae*)  
*asterosporus* (Meyer) Migula  
*atterimus* Leh. and Neu.  
*avisepticus* Kitt (*see Pasteurella aviseptica*)  
*bibulus* McBeth & Scales (*see Bacterium bibulum*)  
*bifidus* Tissier (*see Lactobacillus bifidus*)  
*botulinus* van Ermengem (*see Clostridium botulinum*)

## Bacillus—Continued.

*bovisepiticus* Kruse (*see Pasteurella bovisepctica*)  
*brevis* Migula  
*bronchianis* Ferry (*see Bact. bronchianis*)  
*bronchisepticus* Ferry<sup>4</sup> (*see Bact. bronchisepticum*)  
*buccalis* Robin (*see Leptotrichia buccalis*)  
*bulgaricus* Massol (*see Lactobacillus bulgaricus*)  
*Bütschlii*  
*butyricus* Hueppe  
*butyricus* Botkin (*see Clostridium butyricum*)  
*campestris* Pammel (*see Pseudomonas campestris*)  
*capsulatus* Sternberg (*see Bact. capsulatum*)  
*capsulatus-mucosus* Fasching (*see Bact. mucosum-capsulatum*)  
*carotovorus* Jones (*see Erwinia carotovora*)  
*caucasicus* Flügge (*see Lactobacillus caucasicus*)  
*centrosporus* Ford  
*cerasus* Griffin (*see Pseudomonas cerasa*)  
*cereuleus* Voges (*see Pseudomonas cereulea*)  
*cereus* Frankland  
*chauvei* Arloing-Cornevin-Thomas (*see Clostridium chauvei*)  
*cholerae* Koch (*see Vibrio cholerae*)  
*cholerae-gallinarum* Flügge (*see Pasteurella cholerae-gallinarum*)  
*cholerae-suis* Salmon-Smith (*see Bact. cholerae-suis*)  
*circulans* Jordan  
*citri* Hasse (*see Pseudomonas citri*)  
*cloacae* Jordan (*see Bact. cloacae*)  
*cohaerens* Gottheil  
*coli* Escherich (*see Bact. coli*)  
*coli-communior* Durham (*see Bact. coli communior*)  
*coli-communis* Escherich (*see Bact. coli-communis*)

- Bacillus—Continued.
- comma* Koch (*see* *Vibrio comma*)
  - cosecoroba* Trétop (*see* *Bact. cosecoroba*)
  - cuniculicida* (Gaffky) Flügge (*see* *Pasteurella cuniculicida*)
  - cyanogenes* Flügge (*see* *Pseudomonas cyanogenes*)
  - cypripedii* Hori (*see* *Erwinia cypripedii*)
  - cytaseus* McBeth & Scales (*see* *Bact. cytaseum*)
  - Danysz* (*see* *Bact. Danysz*)
  - Delbrücki* (*see* *Lactobacillus Delbrücki*)
  - diphtheriae* Klebs-Loeffler (*see* *Corynebacterium diphtheriae*)
  - dysenteriae* Flexner (*see* *Bact. dysenteriae*)
  - dysenteriae* Shiga (*see* *Bact. dysenteriae* or *Bact. Shigae*)
  - edematis* Koch (*see* *Clostridium edematis*)
  - Ellenbachensis*  $\alpha$  Stutzer-Hartleb
  - enteritidis* Gärtner (*see* *Bact. enteritidis*)
  - enteritidis-sporogenes* Klein (*see* *Clostridium enteritidis-sporogenes*)
  - erysipelatos-suis* (Löffler) Migula (*see* *Erysipelothrix erysipelatos-suis*)
  - erythrogenes* Grotenfelt (*see* *Erythrobacillus erythrogenes*)
  - fecalis-alcaligenes* Petruschky (*see* *Bact. fecalis-alcaligenes*)
  - feseri* (Trev.) Kitt (*see* *Clostridium feseri*)
  - fimi* McBeth & Scales (*see* *Bact. fimi*)
  - flavidus* Morse (*see* *Corynebacterium flavidum*)
  - fluorescens liquefaciens* Flügge (*see* *Pseudomonas fluorescens*)
  - Friedmanii* (*see* *Mycobacterium Friedmanii*)
  - Frostii* (*see* *Pseudomonas Frostii*)
  - fuchsinus* Boekhout-de Vries (*see* *Erythrobacillus fuchsinus*)
  - fusiformis* Gottheil
  - Bacillus*—Continued.
  - fusiformis* Veillon and Zuber? (*see* *Fusiformis*)
  - gallinarum* Klein (*see* *Bact. gallinarum*)
  - globigii* Migula
  - graveolens* Meyer and Gottheil
  - Havaniensis* Sternberg (*see* *Erythrobacillus Havaniensis*)
  - Hoagii* Morse (*see* *Corynebacterium Hoagii*)
  - Hoffmannii* Loeffler (*see* *Corynebacterium Hoffmannii*)
  - hyacinthi* Wakker? (*see* *Pseudomonas hyacinthi*)
  - icteroides* Sanarelli (*see* *Bact. icteroides*)
  - indicus* Koch (*see* *Erythrobacillus indicus*)
  - influenzae* Pfeiffer (*see* *Hemophilus influenzae*)
  - juglandis* Pierce (*see* *Pseudomonas juglandis*)
  - Kiliensis* Fischer and Breunig (*see* *Erythrobacillus Kiliensis*)
  - lachrymans* Erw. Smith and Bryan (*see* *Pseudomonas lachrymans*)
  - lactic-acidi* Grotenfelt (*see* *Bact. acidi-lactic*)
  - lactic* Flügge
  - lactic-acidi* Leichmann (*see* *Lactobacillus lactic-acidi* or *Streptococcus lacticus*)
  - (*lactic*) *aerogenes* Escherich (*see* *Bact. aerogenes*)
  - (*lactic*) *erythrogenes* Grotenfelt (*see* *Erythrobacillus erythrogenes*)
  - lactic-viscosus* Adametz (*see* *Bact. lactic-viscosus*)
  - lacunatus* Morax and Axenfeld (*see* *Hemophilus lacunatus*)
  - laterosporus* Ford
  - lathyri* Manns and Taubenhaus (*see* *Erwinia lathyri*)
  - leprae* Hansen (*see* *Mycobacterium leprae*)
  - levans* Lehmann-Wolffin (*see* *Bact. levans*)

*Bacillus—Continued.*

*iodermos* (Flügge) Leh. and Neu.  
*lividus* Flüge and Proskauer (*see*  
*Chromobacterium lividum*)  
*mallei* Loeffler and Schütz (*see* Pfeif-  
ferella mallei)  
*malvacearum* Erw. Smith (*see* Pseu-  
domonas malvacearum)  
*medicaginis* Sackett (*see* Pseudomo-  
nas medicaginis)  
*megatherium* de Bary  
*meliensis* (Bruce)<sup>4</sup> (*see* Bact. meli-  
ensis)  
*melonis* Giddings (*see* Erwinia mel-  
onis)  
*mesentericus* (Flügge) Migula  
*miniaceus* Zimmermann (*see* Ery-  
throbacillus miniaceus)  
*mirabilis* Migula (*see* Proteus mira-  
bilis)  
*mori* Boyer and Lambert (*see* Pseu-  
domonas mori)  
*mortiferus* Harris (*see* Fusiformis  
mortiferus)  
*mucosus* Zimmermann  
*murisepticus* Flügge (*see* Bact. mur-  
isepticum)  
*murium* Loeffler (*see* Bact. murium)  
*mycoides* Flügge  
*mycoides-roseus* Scholl (*see* Erythro-  
bacillus mycoides-roseus)  
*neapolitanus* Fraenkel (*see* Bact.  
neapolitanum)  
*niger* Migula  
*of Achalme* (*see* Clostridium Welchii)  
*of Boas-Oppler* (*see* Lactobacillus  
bulgaricus)  
*of Bordet-Gengou* (*see* Hemophilus  
pertussis)  
*of Ducrey* (*see* genus Hemophilus)  
*of Gärtner* (*see* Bact. enteritidis)  
*of Klebs-Loeffler* (*see* Corynebac-  
terium diphtheriae)  
*of Koch-Weeks* (*see* genus Hemophilus)  
*of Morax-Axenfeld* (*see* Hemophilus  
lacunatus)  
*of Morgan* (*see* Bact. Morgani)

*Bacillus—Continued.*

*of Schottmüller* (*see* Bact. Schott-  
mülleri)  
*of Shiga* (*see* Bact. Shigae)  
*of Sternberg* (*see* Bact. Sternbergii)  
*oleae* (Arcangeli) Trev. (*see* Pseudo-  
monas oleae)  
*oleraceae* Harrison (*see* Erwinia oler-  
aceae)  
*oligocarbophilus* Beijerinck and van  
Delden (*see* Carboxydomonas oli-  
gocarbophila)  
*ozaenae* (Abel) Leh. and Neu, (*see*  
Bact. ozaenae)  
*panis* Migula  
*pantotrophus* Kaserer (*see* Hydro-  
genomas pantotropha)  
*paracoli* Widal & Nobecourt (*see*  
Bact. paracoli)  
*parady-enteriae* (*see* Bact. paradys-  
enteriae)  
*paralyticans* Ford-Robertson (*see*  
Corynebacterium paralyticans)  
*paratyphi* Schottmüller (*see* Bact.  
paratyphi)  
*paratyphosus A* Schottmüller (*see*  
Bact. paratyphosum A)  
*paratyphosus B* Schottmüller (*see*  
Bact. paratyphosum B)  
*perfringens* Veillon & Zuber (*see*  
Clostridium perfringens)  
*pertussis* Bordet and Gengou (*see*  
Hemophilus pertussis)  
*pestis* Kitasato and Yersin (*see* Pas-  
teurella pestis)  
*pestis-caviae* (*see* Pasteurella pestis-  
caviae)  
*petasites* Gottheil  
*phaseoli* Smith (*see* Pseudomonas  
phaseoli)  
*phlegmone-s-emphysematosae* Fraen-  
kel (*see* Clostridium phlegmone-  
emphysematosae)  
*phosphorescens* Fischer (*see* Vibrio  
phosphorescens)  
*phytophthora* Appel (*see* Erwinia  
phytophthora)

- Bacillus—Continued.
- plicatus Frankland (*see* Pseudomonas plicata)
  - Plymouthensis Fischer (*see* Erythrobacillus Plymouthensis)
  - pneumoniae Friedländer (*see* Bact. pneumoniae)
  - Prausnitzii Trevisan
  - prodigiosus (Ehrenberg) (*see* Erythrobacillus prodigiosus)
  - proteus-fluorescens Jaeger (*see* Pseudomonas protea-fluorescens)
  - proteus-mirabilis (Hauser) (*see* Proteus mirabilis)
  - proteus-vulgaris (Hauser) (*see* Proteus vulgaris)
  - proteus-Zenkeri (Hauser) (*see* Zopfius Zenkeri)
  - pruni Erw. Smith (*see* Pseudomonas pruni)
  - pseudo-anthracis Burri
  - pseudodiphtheriae Loeffler (*see* Corynebacterium pseudodiphtheriae)
  - pseudo-tetanicus (Kruse) Migula
  - psittacosis Nocard (*see* Bact. psittacosis)
  - pullorum Rettger (*see* Bact. pullorum)
  - putrificus Flügge (*see* Clostridium putrificum)
  - pyocyanus Gessard (*see* Pseudomonas pyocyanaea)
  - pyogenes-foetidus Passet (*see* Bact. pyogenes-foetidum)
  - radicicola Beijerinck (*see* Rhizobium radicicola)
  - ramosus Frankland
  - rhinoscleromatis v. Frisch (*see* Bact. rhinoscleromatis)
  - rosaceus Migula (*see* Erythrobacillus rosaceus)
  - ruber Miquel (*see* Erythrobacillus ruber)
  - ruber Zimmermann (*see* Erythrobacillus ruber)
  - rubricus Hefferan (*see* Erythrobacillus rubricus)
  - ruminatus Gottheil
- Bacillus—Continued.
- rutilescens Hefferan (*see* Erythrobacillus rutilescens)
  - rutilus Hefferan (*see* Erythrobacillus rutilus)
  - salmoneus Dyar (*see* Erythrobacillus salmoneus)
  - sanguinarium Moore (*see* Bact. sanguinarium)
  - Savastanoi Erw. Smith (*see* Pseudomonas Savastanoi)
  - segmentosus (*see* Corynebacterium segmentosum)
  - Shigae Chester (*see* Bact. Shigae)
  - simplex Gottheil
  - smegmatis Alvarez-Tavel (*see* Mycobacterium smegmatis)
  - solanacearum Erw. Smith (*see* Erwinia solanacearum)
  - solanisaprus Harrison (*see* Erwinia solanisapra)
  - sporogenes Klein (*see* Clostridium sporogenes)
  - Sternbergii (*see* Bact. Sternbergii)
  - Stewarti Erw. Smith (*see* Pseudomonas Stewarti)
  - subtilis Cohn
  - subtilis-viscosus Chester
  - subviscorum Migula (*see* Bact. subviscorum)
  - suipestifer Kruse (*see* Bact. suipestifer)
  - suisepticus Kruse (*see* Pasteurella suiseptica)
  - synxanthus Ehrenberg (*see* Pseudomonas synxantha)
  - terminalis Migula
  - tetani Nicolaier (*see* Clostridium tetani)
  - tracheophilus Erw. Smith (*see* Erwinia tracheiphila)
  - tuberculosis Koch (*see* Mycobacterium tuberculosis)
  - tumefaciens Erw. Smith and Townsend (*see* Pseudomonas tumefaciens)
  - tumescens Zopf
  - typhi (*see* Bact. typhi)

## Bacillus—Continued.

- typhi-exanthematici Plotz (see *Fusiformis typhi-exanthematici*)
- typhi-murium Loeffler (see *Bact. typhi-murium*)
- typhi-suis (see *Bact. typhi-suis*)
- typhosus Eberth-Gaffky (see *Bact. typhosum*)
- vascularum Cobb-Erw. Smith (see *Pseudomonas vascularum*)
- violaceus (Schröter) Migula (see *Pseudomonas violacea*)
- vulgaris (Hauser) (see *Proteus vulgaris*)
- vulgatus (Flügge) Trevisan
- Welchii Migula (see *Clostridium Welchii*)
- x Sternberg (see *Bact. Sternbergii*)
- xerosis Kuschbert-Neisser (see *Corynebacterium xerosis*)
- xylinus Brown (see *Acetobacter xylinum*)
- Zenkeri (Hauser) (see *Zopfius Zenkeri*)
- Zopfii Kurth (see *Zopfius Zopfii*)

## Bacterium abortivium

- abortum (Bang)<sup>4</sup>
- abortum-equii
- acidi-lactici (Grotenfelt)
- aërogenes (Escherich)
- alcaligenes (Petruschky)
- anaerogenes (Lembke)
- angulatum Fromme (see *Pseudomonas angulata*)
- astheniae (Dawson)
- bibulum (McBeth & Scales)
- bronchianis
- bronchisepticum (Ferry)<sup>4</sup>
- campestris Pammel (see *Pseudomonas campestris*)
- capsulatum (Sternberg)
- casei  $\alpha$  Orla-Jensen (see *Lactobacillus casei*)
- casei  $\epsilon$  Orla-Jensen (see *Lactobacillus helveticus*)
- cholerae-suis (Salmon-Smith)
- cloacae (Jordan)

## Bacterium—Continued.

- coli (Escherich)
- coli-communior Durham
- coli-communis Escherich
- communior (Durham)
- coccoroba (Trétop)
- Danysz
- dysenteriae (Flexner)
- dysenteriae (Shiga)
- enteritidis (Gaertner)
- fecalis-alcaligenes Petruschky
- fimi (McBeth & Scales)
- gallinarum (Klein)
- hyacinthi Wakker (see *Pseudomonas hyacinthi*)
- icteroides (Sanarelli)
- lactis acidi (Leichmann) (see *Lactobacillus lactis acidi* or *Streptococcus lacticus*)
- lactis viscosus
- lepisepicum Ferry (see *Pasteurella lepisepctica*)
- levans (Lehmann-Wolffin)
- melitensis (Bruce)<sup>4</sup>
- Morgani (Winslow-Rottenberg-Parsons)
- mucosum capsulatum (Fasching)
- murisepticum (Flügge)
- neapolitanum (Fraenkel)
- ozaenae [(Abel) Leh. and Neu.]
- paracoli (Widal & Nobecourt)
- paradynteriae
- paratyphi
- paratyphosum A (Schottmüller)
- paratyphosum B (Schottmüller)
- pestis (Kitasato and Yersin) (see *Pasteurella pestis*)
- phaseoli Erw. Smith (see *Pseudomonas phaseoli*)
- psittacosis (Nocard)
- pullorum (Rettger)
- putidum Flügge (see *Pseudomonas fluorescens* var. *non liquefaciens*)
- pyogenes foetidum (Passet)
- rhinoscleromatis (v. Frisch)
- sanguinarium (Moore)
- Savastanoi Erw. Smith (see *Pseudomonas Savastanoi*)

## Bacterium—Continued.

- Schottmülleri* (Winslow-Rottenberg-Parsons)
- Shigae* (Winslow-Rottenberg-Parsons)
- Sternbergii*
- Stewarti* Erw. Smith (*see Pseudomonas Stewarti*)
- suipestifer* (Kruse)
- tularensis* McCoy and Chapin
- typhi-exanthematici* (Plotz) (*see Fusiformis typhi-exanthematici*)
- typhi-murium* (Loeffler)
- typhi-suis*
- typhosum* (Eberth-Gaffky)
- vulgare* (Hauser) (*see Proteus vulgaris*)
- xylinum* (Brown) (*see Acetobacter xylinum*)
- Zopfii* Kurth (*see Zopfius Zopfii*)
- Betacoccus arabinosaceus* Orla-Jensen (*see Leuconostoc arabinosaceus*)
- bovis* Orla-Jensen (*see Leuconostoc bovis*)
- Carboxydomonas*
- oligocarbophila* Beijerinck and van Delden
- Chromobacterium*
- amethystinum*-(Eisenberg)
- janthinum* (Zopf)
- lividum* (Flügge-Proskauer)
- violaceum* Bergonzini
- Clostridium*
- aerogenes-capsulatum* (Welch & Nuttall)
- amylobacter* (van Tieghem)
- anthracis-symptomatici* (Kruse)
- botulinum* (van Ermengem)
- butyricum* (Botkin)
- butyricum* Prazmowski
- chauvei* (Arloing-Cornevin-Thomas)
- edematis* (Koch)
- enteritidis* sporogenes
- feseri* (Trev.-Kitt)
- pasteurianum* (Winogradsky)
- perfringens*

## Clostridium—Continued.

- phlegmone emphysematosae* (Fraenkel)
- putrificum* (Flügge)
- sporogenes* Klein
- tetani* (Nicolaier)
- Welchii* (Migula)
- Corynebacterium*
- diphtheriae* (Klebs-Loeffler) Leh. and Neu.
- Hoagii* (Morse)
- Hoffmannii* (Loeffler-Hoffman-Wellenhoff)
- segmentosum*
- xerosis* (Kuschbert-Neisser)
- Diplococcus flavus* Flügge (*see Micrococcus flavus*)
- gonorrhoeae* Neisser (i*see Neisseria gonorrhoeae*)
- intracellularis-meningitidis* Weichselbaum (*see Neisseria intracellularis-meningitidis*)
- involutus* Kurth
- lanceolatus* Foa-Bordoni-Uffreduzzi
- mucosus* (Schottmüller)
- pneumoniae* Weichselbaum
- Weichselbaumii* (*see Neisseria Weichselbaumii*)
- Erwinia*
- amylovora* (Burrill-Trev.) Committee 1917
- aroideae* (Townsend)
- carotovora* (Jones)
- lathyri* (Manns and Taubehaus)
- melonis* (Giddings)
- oleraceae* (Harrison)
- phytophthora* (Appel)
- solanacearum* (Erw. Smith)
- solanisapra* (Harrison)
- teutlia* (Metcalf)
- tracheiphila* (Erw. Smith)
- Erysipelothrix*
- erysipelatos-suis*
- rhusiopathiae* Kitt

<b>Erythrobacillus</b>	<b>Lactobacillus—Continued.</b>
<i>amyloruber</i> (Hefferan)	<i>caucasicus</i> Flügge
<i>erythrogenes</i> (Grotenfelt) <sup>5</sup>	<i>cereale</i> (Orla-Jensen)
<i>fuchsinus</i> (Boekhout & de Vries)	<i>Delbrücki</i>
<i>havaniensis</i> (Sternberg)	<i>helveticus</i> (Orla-Jensen)
<i>indicus</i> (Koch)	<i>jugurt</i> (Orla-Jensen)
<i>Kiliensis</i> (Fischer & Breunig)	<i>lactis</i> (Orla-Jensen)
( <i>lactis</i> ) <i>erythrogenes</i> (Grotenfelt) <sup>6</sup>	<i>lactis-acidi</i> Leichmann
<i>miniaceus</i> (Zimmermann)	<i>planticus</i> (Orla-Jensen)
<i>mycooides-roseus</i> (Scholl)	
<i>Plymouthensis</i> (Fischer)	<b>Leptotrichia buccalis</b> Robin
<i>prodigiosus</i> (Ehrenberg)	<b>Leuconostoc arabinosaceus</b> (Orla-Jen-
<i>rubefaciens</i> (Zimmermann)	sen)
<i>ruber</i> (Miquel)	<i>bovis</i> (Orla-Jensen)
<i>ruber</i> (Zimmermann)	<i>mesenteroides</i> (Cienkowski) van Tie-
<i>rubricus</i> (Hefferan)	ghem
<i>rufus</i> (Hefferan)	
<i>rutilescens</i> (Hefferan) <sup>5</sup>	<b>Methanomonas methanica</b> Söhngen
<i>rutilus</i> (Hefferan)	
<b>Fusiformis acnes</b>	<b>Micrococcus acne</b> ( <i>see</i> <i>Staphylococcus</i>
<i>Hodgkini</i>	<i>acne</i> )
<i>termitidis</i> (Hoelling)	<i>agilis</i> Ali-Cohen ( <i>see</i> <i>Rhodococcus</i>
<i>typhi-exanthematici</i> (Plotz)	<i>agilis</i> )
<b>Hemophilus</b> of Ducrey <sup>6</sup>	<i>candicans</i> Flügge ( <i>see</i> <i>Staphylococ-</i>
<i>influenzae</i> (Pfeiffer)	<i>candicans</i> )
of Koch-Weeks <sup>6</sup>	<i>candidus</i> Cohn ( <i>see</i> <i>Staphylococcus</i>
<i>lacunatus</i> (Morax-Axenfeld)	<i>candidus</i> )
<i>pertussis</i> (Bordet-Gengou)	<i>casei</i>
<b>Hydrogenomonas</b>	<i>catarrhalis</i> Pfeiffer ( <i>see</i> <i>Neisseria</i>
<i>pantotropha</i> Kaserer	<i>catarrhalis</i> )
<b>Lactobacillus</b>	<i>cinnabareus</i> Flügge ( <i>see</i> <i>Rhodococ-</i>
<i>acidificans-longissimus</i>	<i>eus cinnabareus</i> )
<i>acidophil-aerogenes</i> (Torrey-Rahe)	<i>citreus</i> Dyar
<i>acidophilus</i> (Moro)	<i>citreus</i> Passet
<i>bifidus</i> (Tissier)	<i>flavus</i> (Flügge) Migula
<i>bulgaricus</i> (Massol)	<i>gonorrhoeae</i> (Trevisan) ( <i>see</i> <i>Neisseria</i>
<i>casei</i> (Orla-Jensen)	<i>gonorrhoeae</i> )
	<i>intracellularis</i> Weichselbaum ( <i>see</i>
	<i>Neisseria intracellularis</i> )
	<i>lanceolatus</i> Foa-Bordoni-Uffreduzzi
	( <i>see</i> <i>Diplococcus</i> )

<sup>5</sup> These organisms contain a water-soluble red pigment in contrast to the lipochrome of the organisms of the true *prodigiosus* group. They are placed here provisionally, but may call for separate generic classification.

<sup>6</sup> The bacillus of Ducrey, and of Koch-Weeks have not been given specific names. They seem to belong to this genus and are placed here awaiting specific names which would be less unwieldly than a genitive form of Ducrey and the combination Koch-Weeks.

- Micrococcus—Continued.**
- liquefaciens
  - luteus (Schroeter) Cohn
  - mastitidis
  - melitensis Bruce (*see* Bact. Melitensis)
  - meningitidis Weichselbaum (*see* Neisseria meningitidis)
  - mycoidermatus
  - mollis Dyar (*see* Staphylococcus mollis)
  - nigrofaciens Northrup
  - ochraceus Rosenthal
  - pharyngis-siccus Lingelsheim (*see* Neisseria pharyngis-siccii)
  - rheumaticus Poynton & Paine (*see* Streptococcus rheumaticus)
  - rhodochrous Zopf (*see* Rhodococcus rhodochrous)
  - rosaceus Frankland (*see* Rhodococcus rosaceus)
  - roseus Flügge (*see* Rhodococcus roseus)
  - ruber = M. (tetragenus) ruber Bujwid (*see* Rhodococcus ruber)
  - tetragenus Gaffky (*see* Staphylococcus tetragenus)
  - ureae Cohn Flügge (*see* Staphylococcus ureae)
  - varians Dyar
  - zymogenes (*see* Streptococcus gracilis)
- Mycobacterium**
- Friedmanii
  - leprae Hansen
  - Moelleri
  - phlei (Moeller) Leh. & Neu.
  - rhusiopathiae Chester (*see* Erysipelothrix rhusiopathiae)
  - smegmatis Alvarez-Tavel
  - tuberculosis (Koch) Leh. & Neu.
- Neisseria**
- catarrhalis (Pfeiffer)
  - gonorrhoeae Trevisan
  - intracellularis Weichselbaum
  - intracellularis-meningitidis Weichselbaum
- Neisseria—Continued.**
- meningitidis (Weichselbaum)
  - pharyngis-sicci (Lingelsheim)
  - Weichselbaumii
- Nitrobacter Winogradskyi**
- Nitrosomonas europaea-Winogradsky javaniensis Winogradsky**
- Pasteurella**
- aviseptica (Kitt)
  - bovisepctica (Kruse)
  - choleræ-gallinarum (Flügge) Treviranus
  - cuniculicida (Gaffky-Flügge)
  - lepisepтика (Ferry)
  - pestis (Kitasato-Yersin)
  - suiseptica (Kruse)
- Pfeifferella mallei** (Loeffler) Buchanan
- Proteus**
- fluorescens Jaeger (*see* Pseudomonas protea fluorescens)
  - mirabilis Hauser
  - vulgaris Hauser
  - Zenkeri Hauser (*see* Zopfius Zenkeri)
- Pseudomonas**
- aeruginosa (Schroeter) Frost?
  - angulata (Fromme)
  - aquatilis (Tataroff)
  - beticola (Smith)
  - campestris (Pammel)
  - cerasa (Griffin)
  - cereulea (Voges)
  - citri (Hasse)
  - cyanogenes
  - fluorescens (Flügge) Migula Frostii
  - hyacinthi (Wakker?)
  - juglandis (Pierce)
  - lachrymans (Erw. Smith and Bryan)
  - malvacearum (Erw. Smith)
  - medicaginis (Sackett)
  - mori (Boyer-Lambert)
  - oleae (Arcangeli-Trev.)
  - phaseoli (Erw. Smith)
  - pisii Sackett

*Pseudomonas—Continued.*

*protea* Frost  
*protea-fluorescens* (Jaeger)  
*pruni* (Erw. Smith)  
*pyocyanea* Gessard  
*Savastanoi* (Erw. Smith)  
*Stewarti* (Erw. Smith)  
*syncyanea* Ehrenberg  
*synxantha* (Ehrenberg) Cohn  
*tumefaciens* (Erw. Smith and Townsend)  
*vascularum* (Cobb-Erw. Smith)  
*viridilivida* Brown

*Rhizobium leguminosarum* Frank  
*radicicola* (Beijerinck)

*Rhodococcus agilis* (Ali-Cohen)  
*cinnabareus* (Flügge)  
*fulvus* Cohn  
*incarnatus* Gruber  
*rhodochrous* Zopf  
*rosaceus* (Frankland)  
*roseus* (Flügge)  
*ruber* (Bujwid)

*Sarcina*

*aurantiaca* (Schröter-Cohn)  
*flava* De Bary  
*lutea* Schröter  
*rosea* Schröter (*see Rhod. roseus*)  
*subflava* Ravenel  
*ventriculi* Goodsir

*Spirillum*

*cholerae-asiatica* Zopf (*see Vibrio cholerae-asiaticae*)  
*concentricum* Kitasato  
*danunicum* Heider (*see Vibrio danunicus*)  
*desulfuricans* Beijerinck (*see Vibrio desulfuricans*)  
*Ghinda* Kruse (*see Vibrio Ghinda*)  
*Massowah* Pasquale-Pfeiffer (*see Vibrio Massowah*)  
*Metchnikovi* Gamaleia (*see Vibrio Metchnikovi*)  
*Milleri* (*see Vibrio Milleri*)  
*of Deneke* (*see Vibrio tyrogenus*)

*Spirillum—Continued.*

*of Finkler-Prior* (*see Vibrio Finkleri*)  
*phosphorescens* Fischer (*see Vibrio phosphorescens*)  
*rubrum* v. Esmarch  
*serpens* Müller-Zettnow  
*tyrogenum* Deneke (*see Vibrio tyrogenus*)  
*undula* Ehrenberg  
*volutans* Ehrenberg

*Staphylococcus*

*acne*  
*albus*  
*aurantiacus-Schröter-Cohn* (*see Sarcina aurantiaca*)  
*aureus* Rosenbach  
*candicans* (Flügge)  
*candidus*  
*canescens* Migula  
*cereus-albus* Passet  
*cereus-flavus* Passet  
*epidermidis*  
*mollis* (Dyar)  
*pyogenes-albus* Rosenbach  
*pyogenes-aureus* Rosenbach  
*tetragenus* (Gaffky)  
*ureae* (Cohn-Flügge)

*Streptobacterium casei* (*see Lactobacillus casei*)*Streptobacterium plantarum* (*see Lactobacillus plantarum*)*Streptococcus*

*bovis* Orla-Jensen  
*conglomeratus* Kurth  
*cremoris* Orla-Jensen  
*endocarditis*  
*epidemicus* Davis  
*erysipelatos* Fehleisen  
*faecium* Orla-Jensen  
*glycerinaceus* Orla-Jensen  
*gracilis* Escherich  
*hemolyticus* Rolly  
*inulinaceus* Orla-Jensen  
*lacticus* Kruse  
*lacticus-mastitidis* Orla-Jensen

Streptococcus— <i>Continued.</i>	Thermobacterium— <i>Continued.</i>
<i>lactis</i> Orla-Jensen	<i>helveticum</i> Orla-Jensen ( <i>see Lactobacillus helveticus</i> )
<i>liquefaciens</i> Orla-Jensen	<i>jugurt</i> Orla-Jensen ( <i>see Lactobacillus jugurt</i> )
<i>mucosus</i> Schottmüller ( <i>see Diplococcus mucosus</i> )	
<i>pneumoniae</i> Weichselbaum ( <i>see Diplococcus pneumoniae</i> )	
<i>pyogenes</i> Rosenbach	Vibrio
<i>rheumaticus</i> (Poynton & Paine)	<i>aquatalis</i> Günther
<i>thermophilus</i> Orla-Jensen	<i>berolinensis</i> Migula
<i>viridans</i> Schottmüller	<i>cholerae-asiaticae</i> (Zopf)
<i>zymogenes</i>	<i>comma</i> Schröter
Tetracoccus liquefaciens ( <i>see Micrococcus liquefaciens</i> )	<i>danubicus</i> (Heider)
<i>casei</i> ( <i>see Micrococcus casei</i> )	<i>desulfuricans</i> (Beijerinck)
<i>mastitidis</i> ( <i>see Micrococcus mastitis</i> )	<i>Dunbari</i>
<i>mycodermatus</i> ( <i>see Micrococcus mycodermatus</i> )	<i>fetus</i> Th. Smith
Thermobacterium	<i>Finkleri</i> (Schröter)
<i>cereale</i> Orla-Jensen ( <i>see Lactobacillus cereale</i> )	<i>Ghinda</i> (Kruse)
<i>lactis</i> Orla-Jensen ( <i>see Lactobacillus lactis</i> )	<i>Massowah</i> (Pasquale-Pfeiffer)
<i>bulgaricum</i> Orla-Jensen ( <i>see Lactobacillus bulgaricus</i> )	<i>Metchnikovi</i> (Gamaleia)
	<i>Milleri</i>
	<i>phosphorescens</i> (Fischer)
	<i>proteus</i> Buchner
	<i>Schuytkillensis</i> Abbott
	<i>tyrogenus</i> (Deneke)
	Zopfius
	<i>Zenkeri</i> (Hauser)
	<i>Zopfii</i> (Kurth)

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